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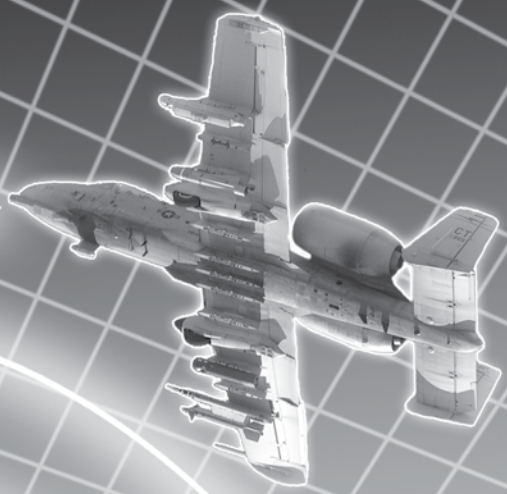


By Colonel John L. Haithcock, Jr.

Network-centric warfare (NCW) broadly describes the combination of strategies; emerging tactics, techniques and procedures; and organizations that a fully, or even partially, networked force can employ to create a decisive warfighting advantage. The *future joint command and control* ($JC^2$) network, a system of systems, will enable NCW, supporting Army, joint and coalition operations.

The $JC^2$ will be the Department of Defense's (DoD's) primary command and control information network. It will give commanders unprecedented decision superiority using advanced collaborative information sharing via vertical and horizontal network interoperability.

As one of the $JC^2$ subsystems, the Army's *future combat system battle command system (FCS BC)* will provide the services to enable networked fires. These services will be a combination of sensors (manned and unmanned), automated $C^2$ systems, and lethal and nonlethal platforms and capabilities networked to achieve shared awareness, speed of command, high operational tempo (OPTEMPO) and nearly autonomous operations—ultimately, supporting real-time Army, joint and coalition fires for the force commander.

The 2005 version of the "Unit of Action Organization and Operation" document used the acronym "NWF" for networked fires. As the Army designated the Field Artillery and Air Defense Artillery merger at Fort Sill, Oklahoma, in 2005, it also has considered naming Fort Sill the NetFires [Networked Fires] Center of Excellence (CoE). The term "NetFires," which once was more narrowly defined, has come to represent the NWF concept.

To understand how NetFires works, we first must understand the development of the broader $JC^2$ network and its subsystems that will enable NetFires.

**Joint Battle Management.** Throughout history, armed forces have modified and adapted to their changing environments. Today, the US military is undergoing a transformation not only to account for current conditions, but also to visualize the future environment. "The National Military Strategy," "Joint Vision 2020" and "Joint Operations Concept" describe future force operations.

The Joint Forces Command (JFCOM) in Norfolk, Virginia, is working with the Chairman of the Joint Chiefs of Staff and geographical combatant commanders to develop the "Joint Battle Management Command and Control ($JBMC^2$) Roadmap." This is the plan to implement NCW. In the roadmap, the joint force will incorporate advanced technologies into current systems, "spinning out" these improved capabilities to move the systems forward to the objective $JC^2$ system. The plan projects establishing the Army's FCS BC under $JC^2$, Version 5, in 2019. (See the figure on Page 24.)

The $JBMC^2$ Roadmap combines several related programs and initiatives to support improved joint interoperability and integration. The result of merging these programs will be a seamless, secure and interoperable global network that will allow the task force commander access to the information he needs to successfully plan, command and execute integrated maneuver and fires from anywhere in the world.

$JC^2$ will support force-level planning, executing, monitoring and assessing of joint and multinational operations using net-centric enterprise services to exchange data across multiple security domains. ("Enterprise services" are those applications available to anyone with access to the network.) $JC^2$ also will be the net-centric migration path for the current *global command and control system (GCCS)* family of systems. The GCCS-Army (GCCS-A) is the Army's subsystem of GCCS.

The GCCS-A "Acquisition Decision Memorandum," 28 May 2002, directed the development of a block implementation plan, identifying operational requirements to implement the Army's part of the $JBMC^2$ Roadmap. The figure shows the Army's battle command systems' migration in block implementations from

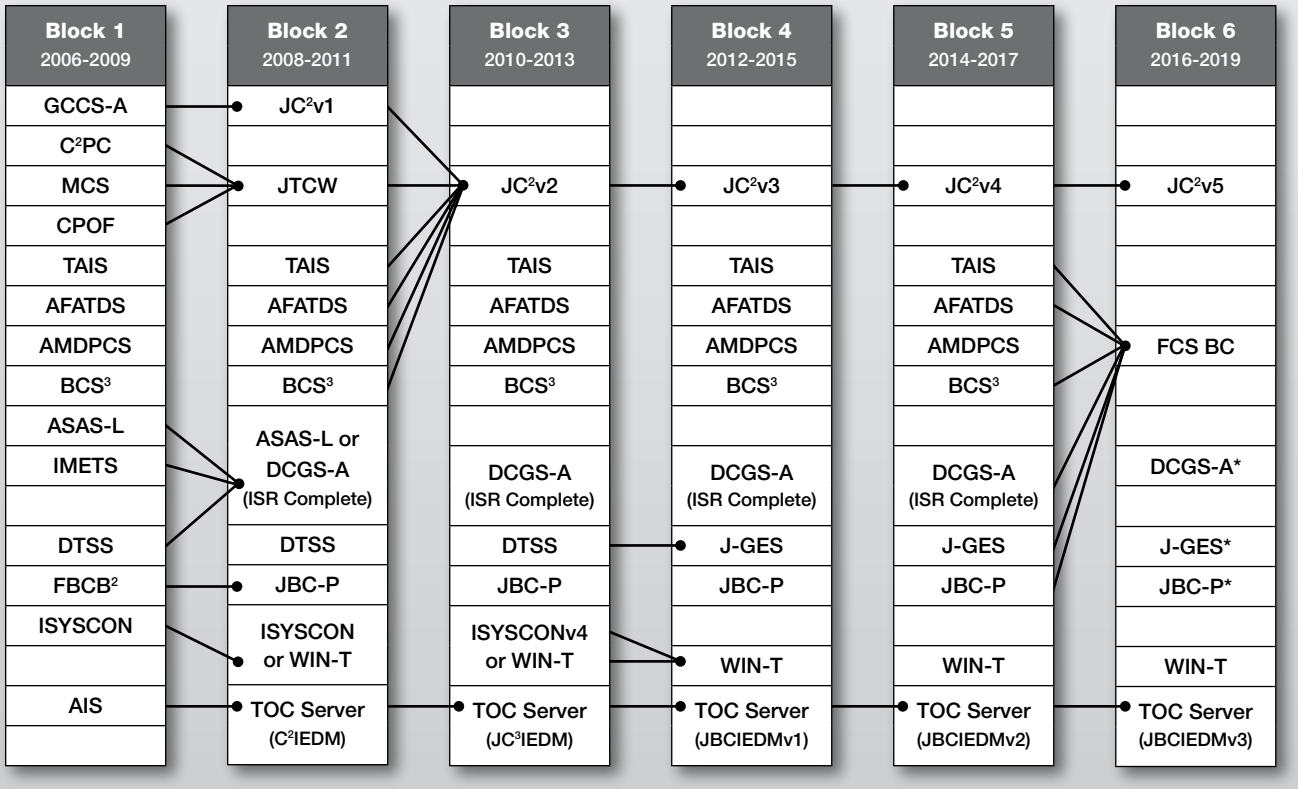
2006 until 2019.

GCCS-A begins the transition to the *global information grid (GIG)*, which is the communications centerpiece of the future network, and the *Army battle command system (ABCS)*. The GCCS and GIG and the common operational picture (COP) they provide will form a solid foundation for evolving command and control capabilities.

The armed services understand that they must link their systems to improve JC$^2$. "Joint Vision 2020" and the "Joint Operations Concepts" describe the operational context for transformation by linking strategic guidance with the integrated application of joint force capabilities. Current systems support the commander's needs but in a disjointed manner that requires operators to have detailed technical knowledge of the systems and spend an inordinate amount of time on them.

The Army has invested a great deal of time, effort and money to develop its robust command and control systems. The Army must address joint architectures, protocols and systems for a redundant, non-terrestrial-based network to provide the focused bandwidth needed to support mobile battle command and joint blue force tracking.

Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) in Afghanistan continue to highlight the successes and potential of network-enabled operations. The advantages of the network in OIF and OEF are powerful—shared situational awareness, enhanced command speed




**These systems will remain for the current/modular brigade combat teams (BCTs) yet to become future combat system (FCS) BCTs (FBCTs).*

***Legend:***

**AFATDS** = Advanced Field Artillery Tactical Data System
**AIS** = Automated Information System
**AMDPCS** = Air and Missile Defense Planning and Control System
**ASAS-L** = All-Source Analysis System-Light
**BCS³** = Battle Command Sustainment Support System
**C²PC** = Command and Control Personal Computer
**C²IEDM** = Command and Control Information Exchange Data Model
**CPOF** = Command Post of the Future
**DCGS-A** = Distributed Common Ground System-Army
**DTSS** = Digital Topographic Support System
**FBCB²** = Force XXI Battle Command Brigade and Below
**GCCS-A** = Global Command and Control System-Army
**IDM-T** = Information Dissemination Manager-Tactical
**IMETS** = Integrated (Mobile) Meteorological Systems
**ISR** = Intelligence, Surveillance and Reconnaissance
**ISYSCON** = Integrated System Control
**JBC-P** = Joint Battle Command-Platform
**JBCIEDM** = Joint Battle Command Information Exchange Data Model
**JC³IEDM** = Joint Consultation Command and Control Information Exchange Data Model
**J-GES** = Joint-Geospatial Enterprise Service
**JTCW** = Joint Tactical COP (Common Operational Picture) Workstation
**MCS** = Maneuver Control System
**TAIS** = Tactical Airspace Integration System
**TOC** = Tactical Operations Center
**WIN-T** = Warfighter Information Network-Tactical

**Battle Command System Migration. Starting in 2006 with the Army Battle Command System (ABCS), Version 6.4, and transitioning to fewer but more capable systems until 2019, the Army's Future Combat System Battle Command System (FCS BC) will be included in the overall Joint Command and Control System (JC²). Note that this chart shows only the migration of Army systems, not all the joint systems that will be under JC².**

and the force's ability to synchronize complex full-spectrum operations.

**Networked Fires.** NetFires operations are enabled by the future force battle command network and supporting communications architecture. Netfires requires access to a combination of relevant sensors, effects capabilities, the battle command system and communications capabilities available across the FBCTs and legacy BCTs.

NetFires will enable the dynamic application of lethal and nonlethal destructive and suppressive effects. It will be integrated fully from the theater level to the tactical platform level, allowing the commander to establish, alter and terminate linkages between sensors and line-of-sight (LOS), beyond-line-of-sight (BLOS), non-line-of-sight (NLOS) division/corps and joint systems to achieve a wide set of lethal and nonlethal effects.

The battle command network will allow the commander to tailor his guidance dynamically and refocus sensors and effects to meet the requirements of the changing situations. With all elements of the FBCT networked, the FBCT will be able to achieve virtual teaming and mutual support and rapidly massed effects without massing forces.

The FCS BC services and its communications architecture will enable NetFires to integrate strike solutions that apply the commander's intent as the "decider." The fires and effects requestor won't need to be concerned about which platforms or units will provide the effects. NetFires automatically will determine the sensor-weapons-target combination to achieve the most responsive and sufficient effects on the target. However, the user will be able to choose the option of reviewing the automated solution before the system implements it or the option of automatic implementation.

NetFires will leverage all relevant Army and joint, interagency and multinational (JIM) sensors and effectors to locate and strike targets with a wide set of lethal and nonlethal effects. This will exploit the entire force's capabilities.

The future force will have access to manned and unmanned ground, air and space Army and JIM sensors collecting information for distribution, processing and use by multiple users. Commanders and staffs at all echelons will have access to this information.

Sensors will gather, transmit and receive very large amounts of data for processing and fusing for the data user. Some information will be of immediate use, such as to strike high-payoff targets (HPTs), time-sensitive targets (TSTs) and most dangerous targets (MDTs). Other information will be less time-sensitive, perhaps used to build an enemy order of battle or forecast the next day's weather.

The FBCT's battle command system will achieve these functions through automation, allowing real-time targeting to support the delivery of responsive fires and effects. The future force battle command network will improve coordination and clearance of fires. Accurate knowledge of the locations of friendly ground forces with the automated execution of policies and attack guidance will allow more rapid responses to enemy targets.

The commander will be able to maintain visibility of Army and JIM manned and unmanned aerial assets (including indirect fire munitions) and the Army airspace command and control ($A^2C^2$) element, which will be part of FCS BC. This will facilitate the FBCT's ability to rapidly prioritize, optimize and deconflict airspace for all its users. Simply put, the battle command network will enable rather than restrict all combat elements' use of airspace.

*Sensor-to-Shooter Link.* Based on mission, enemy, terrain and weather, troops, time available and civil considerations (METT-TC), commanders will be able to establish dedicated sensor-to-shooter links when situations warrant immediately responsive fires to attack HPTs vital to the FBCT's or division's mission. This technique requires a direct link from a target acquisition asset to a dedicated fires platform to engage the target.

Establishing a sensor-to-shooter link will make some sensors and shooters unavailable to the overall network. Therefore, commanders will have to consider the impact on the network when establishing a dedicated sensor-to-shooter relationship.

Nevertheless, this technique, for example, could enable an automated fires link from a sensor to an NLOS launch system (NLOS-LS) to engage a TST. The sensor could be a counterfire radar; an unmanned aerial vehicle (UAV); an attack aviation platform; a near-space platform; another reconnaissance, surveillance and target acquisition (RSTA) system; and (or) a maneuver FCS platform or Soldier. That sensor then would have priority for calls-for-fire to that specific NLOS-LS through battle command NetFires services and its communications architecture.

The following hypothetical scenario illustrates when a commander might employ a sensor-to-shooter link during operations. An armed reconnaissance helicopter (ARH) is on a mission to search for a surface-to-surface missile reloading point deep in enemy territory. The network establishes sensor-to-shooter links between high-mobility artillery rocket system (HIMARS) launchers and the ARH. If the ARH encounters enemy air defense sites, HIMARS can respond immediately with suppression of enemy air defense (SEAD) fires.

*Future Force Targeting.* Future targeting will be similar to the current decide, detect, deliver and assess ($D^3A$) methodology employed today. The battle command system will automate target development by processing and fusing the enormous number of data points gathered. It will use data from all available Army and JIM sensors and existing targeting information for planned, on-call or immediate attack.

The future force battle command system automatically will process calls for effects and fuse information from multiple sources to determine the appropriate entity (unit, system, platform or individual) to achieve the desired effects.

The future force battle command system will enable the effects-based approach to targeting and integrate all effects, including those of maneuver. This cohesive targeting system will apply a wide range of options from a variety of effects providers, generating a synergism that exceeds the application of the parts in isolation.

Consider a lethal effects package of fires from three NLOS-LS, two NLOS-cannons and two Air Force tactical strike aircraft planned in near real-time to attack an HPT. Together, they will be able to provide effects on the target more quickly and effectively than we can today.

Additionally, the future battle command system will precisely track incoming enemy aerial vehicles or missiles (such as medium- and short-range tactical ballistic missiles, cruise missiles, combat aerial vehicles or hostile aircraft). This will allow the Air Defense Artillery's medium-extended air defense system (MEADS) to eliminate these threats. (In the next 15 years, the Patriot missile will incorporate new technologies and morph into MEADS.)

*Fires and Effects Coordination.* Fires and effects coordination will be enabled

by the battle command system and is critical to the success of future force operations.

Perhaps the most significant change from the way we currently coordinate effects will be the consolidation of fires and effects with the command and control of effects delivery platforms. The battle command system not only will fuse sensor data, rapidly producing targetable data, but also route the targeting data to the appropriate fires system. NetFires will balance the need for responsive tactical fires with the most effective application of systems and munitions. Facilitating rapid clearance of fires and airspace coordination is and will remain a key aspect of this process.

The future battle command network will have visibility of all LOS, BLOS and NLOS engagements. This ensures that other resources do not reengage neutralized or destroyed targets. Additional assets then can be directed against targets that were not suppressed or destroyed.

NetFires will execute operations in accordance with the commander's guidance input into the battle command system. Based on the guidance, it may execute operations automatically without human intervention. The guidance may stipulate a human decision for certain conditions, such as violations of restricted targets. The system also may call for human intervention when the situation does not meet the parameters established in the commander's guidance.

Using the services of the battle command network, the Army will be able to protect the force during operations. For example, the future battle command system will use a fratricide avoidance application that checks the locations of friendly units. Current fratricide avoidance procedures focus on established fire support coordinating measures (FSCM). The application will use data about friendly units from Force XXI battle command brigade and below (FBCB$^2$), blue force tracker, and C$^2$ personal computer (C$^2$PC) to identify targeting conflicts that could lead to fratricide or unwanted collateral damage.

The battle command system will use the services of other software applications integrated into the FCS system of systems to conduct attack analysis and determine sensor-weapons-target combinations that are fused with data about the locations of friendly forces. This will provide a detailed analysis of surface fire asset capabilities in engaging and defeating targets. It automatically will consider available sensors, weapons and munitions, response times, commander's guidance, desired effects and time constraints.

Photo by Fred W. Baker III

**A 13P instructor for the New Equipment Training Division at the FA School sends fire missions to an M270A1 launcher using a battery AFATDS "box." Future users will be able to access AFATDS from their computers over the net concurrently with other applications.**

*Other NetFires-Related Web-Based Capabilities.* Computer systems distributed throughout the force will be able to access current and future applications via FCS BC. Examples of current applications are the web-based joint automated deep operations coordination system (JADOCS), C$^2$PC and the Air Force's theater battle management core system (TBMCS).

Another capability will be the incorporation of tactics, techniques and procedures (TTPs) for the common geographic reference system (CGRS). The CGRS will provide a common frame of reference for joint force situational awareness and attack coordination. It also will increase interoperability as various joint systems share data based on the common reference system.

These are just a few of many web-based applications that will be available to anyone with network connectivity and access permission authorized.

**Current Fort Sill Actions.** Fort Sill is looking at technologies to improve the capabilities of current fires systems and, possibly, leverage them for future systems, enhancing NetFires operations. For example, the developmental fire-and-forget Excalibur family of precision-guided munitions (PGMs) will provide tactical munitions with a circular error probable (CEP) of 10 meters or less at all ranges. The Excalibur unitary 155-mm round soon will be fielded in the Central Command (CENTCOM) theater. Another PGM—the guided multiple-launch rocket system (GMLRS)—is already in theater and being employed very successfully.

We also are working with the FCS developmental communities to advance NetFires operational concepts as technologies will allow. To enable our PGMs, precision strike suite-special operating forces (PSS-SOF), which is a proven windows-based software that is part of a future advanced FA tactical data system (AFATDS) release, will allow tactical observers to determine coordinates to employ weapons requiring very accurate target locations.

Our AFATDS has several enhancements under development, including its migration to a windows-based platform, projected for 2008. This will allow units to use AFATDS to access newly developed software and interface more easily with other new C$^2$ systems. These new systems include the command post of the future (CPOF), the web-based execution management capability (WEEMC) and JADOCS. (WEEMC will replace JADOCS.)

In the future, AFATDS users will not require an AFATDS "box." Users will be able to access AFATDS from their computers over the net concurrently with other applications on the battle command network. In addition, units will be able to establish a webpage and post AFATDS information on it for others to access.

An updated version of the forward observer software (FOS) with Excalibur as an option for a call-for-fire will accompany the release of the AFATDS' PSS-SOF application. AFATDS will release a service pack with the Excalibur technical data and an automated message to deconflict airspace and transmit the message to the tactical airspace integration system (TAIS) and TBMCS to help speed airspace deconfliction.

Other capabilities of the battle command network that will help to enable NetFires include an "internet-like" architecture that will allow systems to receive information from other systems and post

information for other systems to access. An example of this is AFATDS' effects management tool (EMT) software. It can access UAV video, ground moving-target indicators, synthetic aperture radar and signal intelligence information from the common ground station.

**The Joint Battle Command Network Issues.** We must resolve several issues to implement JC$^2$ and the FCS BC, which enable NetFires operations.

• *Joint philosophy must allow true joint interdependence.* Current FCS concepts envision joint assets being available to whoever needs them. If a ground maneuver element decides to engage a target, the network will provide the proper platform to achieve the desired effects. It could be an airplane, ship, reaction team or even leaflets, depending on the requested effects. It could entail several joint platforms or capabilities.

To achieve this, the armed services, basically, must relinquish control of their resources to JC$^2$. The joint services also must be familiar with how to employ all assets. For example, the Army is training some 13F Fire Supporters as joint fires observers (JFOs) to provide data to help Air Force personnel terminally control attacking aircraft in close air support (CAS) and to access other joint fires.

Another consideration is joint equipment. The future joint force must have equipment that is interoperable and not specific to a single service.

• *The joint force must physically establish the network, to include its hardware and software.* The joint force must first establish the hardware for the communications from one node to another. But the battle command network system is much more than communications.

We must develop the software to make the decisions for NCW and, ultimately, NetFires. For example, the network must provide the services to access targeting information and decide whether or not to engage the target, automatically clear the target and then decide to whom to send the target for engagement. And the network must be able to send targeting information simultaneously to whoever needs it quickly and accurately.

To build these NCW/NetFires capabilities, we must move toward an internet-like architecture.

• *The joint force must trust the system.* For the networked battle command system to be effective, the armed services will have to trust the system.

In terms of NetFires operations, the joint network must have the software to connect platforms at the different levels and determine restrictions and permissions for human intervention. There is a balance we must maintain: human intervention slows the process, which, at some point, negates the advantages of having the joint battle command network. The determination of the numbers and levels of human intervention may be one of the hardest issues to resolve in the development of the systems to support NetFires.

There has been much discussion about the network providing the means for sensor-to-shooter operations. The first issue to resolve will be to establish a robust clearance of fires application. This application will check the request for effects against not only FSCM already in effect, but also friendly unit locations and restricted and protected target lists, plus assess the potential for collateral damage.

We must integrate systems into the joint network to allow these checks. This will include having fixed-wing aircraft that can display ground forces in their cockpits and have fire control systems able to conduct checks before engaging.

To build commanders' trust in the automated system, the system must be tested thoroughly and commanders must be familiar with its capabilities. Commanders also will have to understand that they will not have "direct support" systems—that the network will be able to choose a platform in their battlespace to engage targets outside their sectors to execute NetFires. Likewise, the network may task systems outside of their sectors to support their operations.

Commanders will have the ability to stipulate whether or not their BLOS weapons can be tasked by the network. Although the network maintains visibility of LOS engagements, it won't task the commanders' LOS weapons.

• *Network implementation will require changes to joint doctrine, organizations, training, leadership and education, materiel, personnel and facilities (DOTMLPF).* The joint force will be able to implement JC$^2$ and NCW as technology allows and the armed services are willing to make DOTMLPF changes.

The armed services all are undergoing transformation. Army units are experiencing high OPTEMPO—not only fighting a war, but also becoming modular while moving toward an FCS-based Army. As we move toward a net-centric environment, we must update training and doctrine rapidly, the latter initially in the form of TTPs—in fact, consider all the DOTMLPF.

As part of network-centric operations, NetFires has the potential for future commanders to apply full-spectrum Army, joint and coalition fires and effects across all levels of conflict in real-time. NetFires will be a critical enabler for rapid and decisive outcomes.

However, to migrate from today's capabilities to tomorrow's NetFires operations, we must execute a comprehensive joint strategy. This calls for implementing the JBMC$^2$ Roadmap and enhancing current and developmental joint C$^2$ and communications systems, and platform and capabilities to interface with JC$^2$. This will provide the Army decision-making and information services via FCS BC—services that will enable NetFires.

The armed services must cooperate to ensure that future Soldiers, Sailors, Airmen and Marines have the tools they need to accomplish any future mission, including the tools to execute Army, joint and coalition NetFires.

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**Colonel John L. Haithcock, Jr., is the Training and Doctrine Command (TRADOC) Systems Manager for FA Tactical Data Systems (TSM FATDS) at Fort Sill, Oklahoma. In a previous assignment, he served as the Assistant TSM FATDS. As the TSM FATDS, he helps develop the Advanced FA Tactical Data System (AFATDS) from the user perspective, which will evolve to be part of the future Joint Command and Control System (JC$^2$). Also at Fort Sill, he was the Deputy Director of the new Joint and Combined Integration Directorate (JACI) in the Field Artillery School. He was the Plans Officer for the 3rd Battlefield Coordination Detachment (BCD) for the Joint and Combined Forces, Korea. He commanded 3rd Battalion, 30th Field Artillery (3-30 FA) at Fort Sill, and A Battery, 6-41 FA, in the 3rd Infantry Division (Mechanized) in Germany. Among other assignments, he was the Deputy Fire Support Trainer and S3 Combat Trainer at the National Training Center (NTC), Fort Irwin, California. He is a graduate of the Army War College at Carlisle Barracks, Pennsylvania.**

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